3.3 SEMIPERMEABLE MEMBRANE DEVICES

The chlorinated pesticide and PAH data for the SPMD samples appear to have been affected by laboratory contamination during the dialysis/extraction procedure. The dialysis blanks prepared during extraction of the field samples and trip blank contained the same suites of pesticide and PAH analytes, and at comparable concentrations, as those in the SPMD samples. By contrast, procedure blanks prepared during cleanup and analysis of the SPMD extracts did not contain detectable concentrations of any of the target analytes. Consequently, it is likely that contamination occurred prior to instrumental analysis. Unfortunately, the presence of contamination may have masked identification and prevented quantification of chlorinated pesticides or PAHs collected by the SPMDs during the exposure period.

Chlorinated Pesticides and Polychlorinated Biphenyls: A suite of pesticides, primarily consisting of DDT and chlordane compounds were present in the SPMD samples as well as the trip blank and dialysis blank. The highest analyte concentrations in the samples were approximately 150 ng/SPMD (for p,p´-DDE). However, most of the detected pesticides were present in the blank at concentrations that were on the same order of magnitude as those in the samples. For some analytes, such as p,p´-DDE, concentrations in the samples were up to an order of magnitude higher than those in the blanks. These differences could be due to variability in contaminant exposures during dialysis. However, because only one dialysis blank was prepared, this variability could not be assessed. Although the source of these analytes in the SPMD samples could be attributable to accidental contamination, *in situ* exposure conditions, or both, it is not possible to apportion the contributions from the various potential sources. Nevertheless, pesticides in the SPMD samples appeared to be due primarily or entirely to contamination during dialysis, and there were no other obvious differences between the shell mound and reference site SPMD samples in the analytes detected or their concentrations that suggested spatial patterns in the levels of dissolved pesticides in bottom waters. In contrast with the pesticides, PCBs (congeners and Aroclors) were not detected in any of the SPMD samples or the trip and dialysis blanks. The absence of PCBs in the dialysis blank indicates that the results for the SPMD samples are reliable. This is verified by the results for recoveries of surrogate compounds spiked into the SPMDs prior to deployment. Recoveries for surrogate PCB congeners ranged from 43 to 51% for PCB 34 and from 66 to 84% for PCB 112, and indicated that any accumulated compounds were not lost during field exposures. In total, these SPMD results showed that PCBs in waters near the shell mounds were below measurable levels.

Polycyclic Aromatic Hydrocarbons: The dialysis blank prepared in the laboratory during extraction (dialysis) of the SPMD lipid bags contained concentrations and relative proportions of individual PAHs that were comparable to those of the exposed SPMD samples. In contrast, the procedure blank prepared during extract cleanup and instru mental analysis did not contain detectable PAHs. These results strongly suggest that the samples were contaminated during the dialysis procedure. Although it was not possible to determine accurately how much of the PAHs measured in the SPMD

samples was due to *in situ* exposure versus laboratory contamination, PAHs appeared to be due primarily or entirely to contamination during dialysis. Further, there were no other obvious differences between the shell mound and reference site SPMD samples in the analytes detected or their concentrations that suggested spatial patterns in the levels of dissolved PAHs in bottom waters.

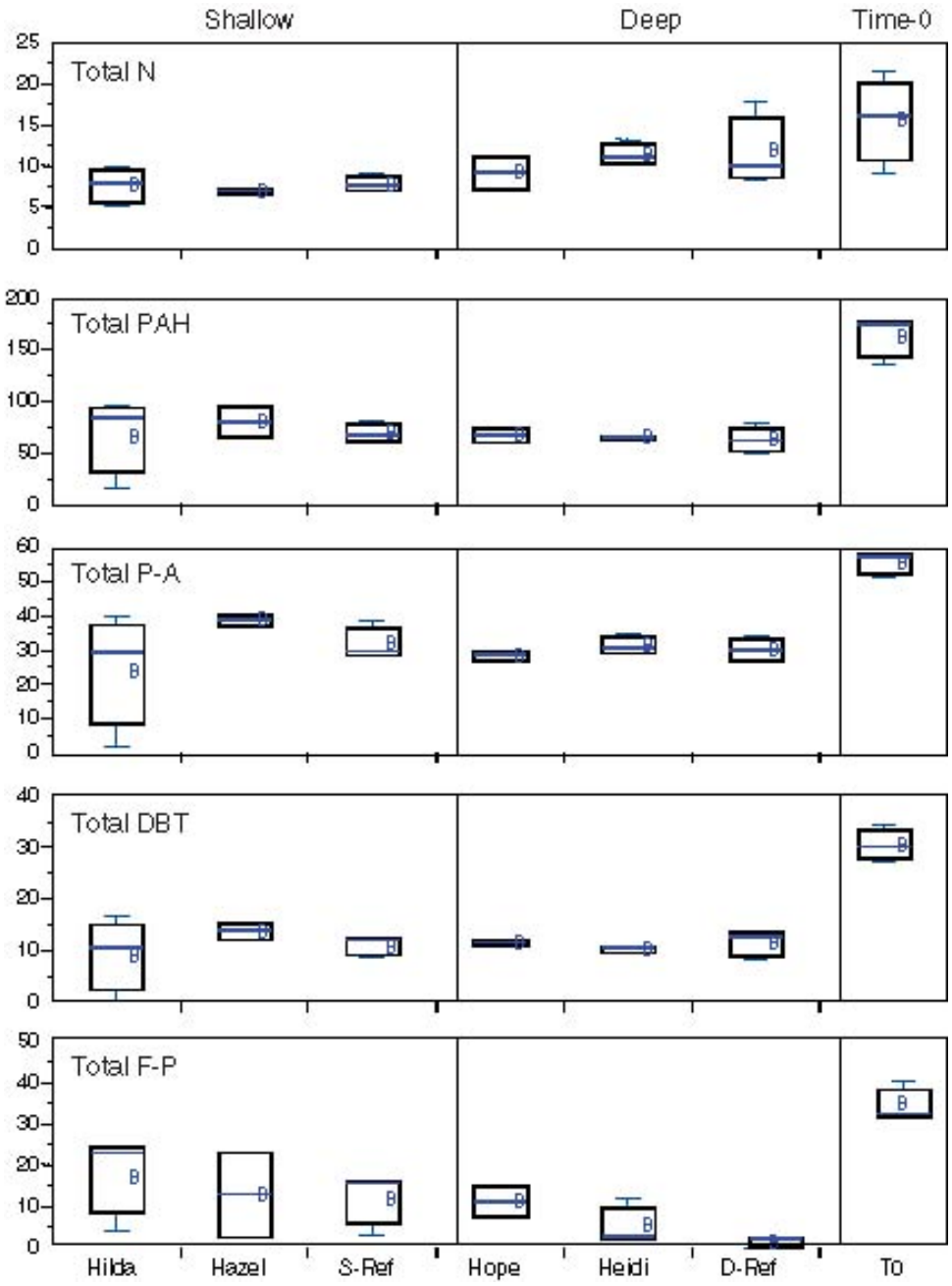

Figure 3.2-11. Box-Whisker Plots of PAH Concentrations (ng/g dry weight) in Mussel Tissues (The top, middle, and bottom horizontal line represents the 75th, 50th, and 25th percentiles, respectively, the symbol within the box represents the mean, and the vertical lines (whiskers) represent the 10th and 90th percentiles.)

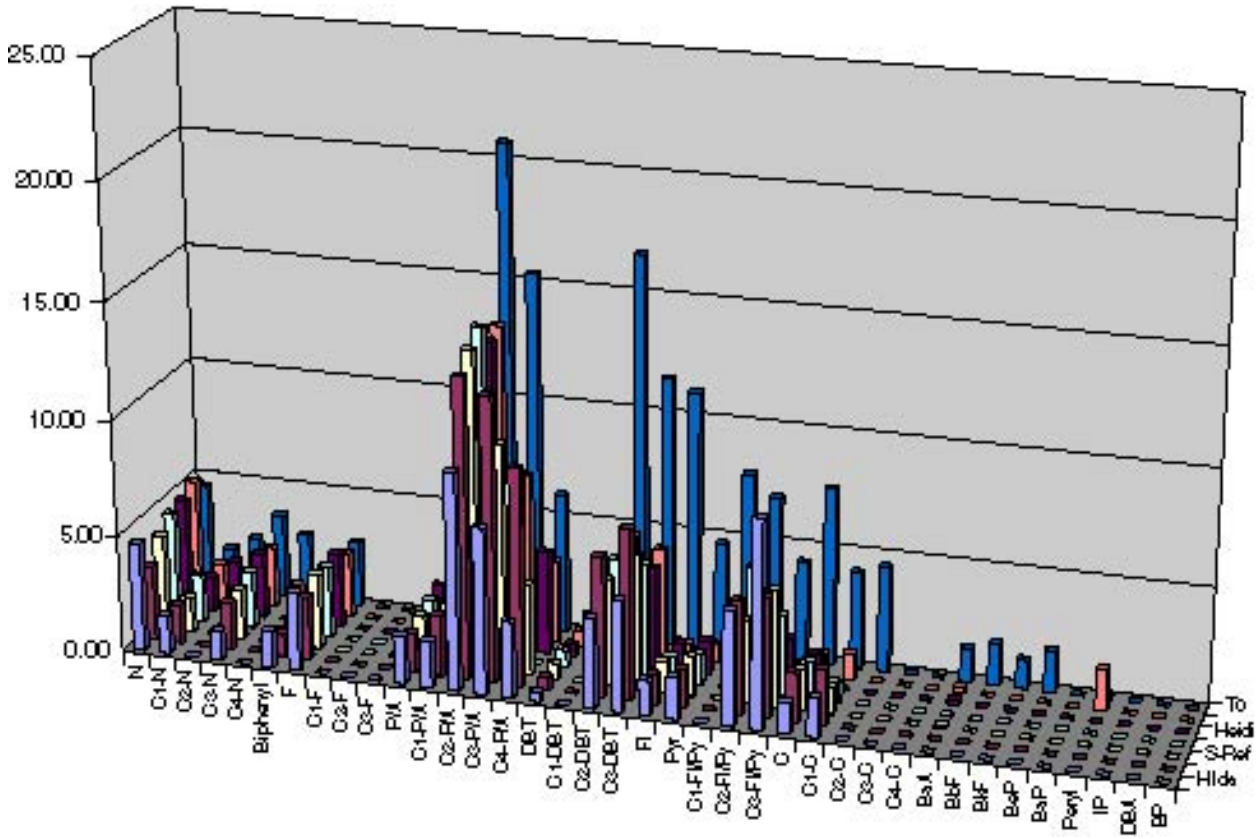

Figure 3.2-12. Concentrations of Individual PAHs (ng/g dry weight) in Shell Mound and Reference Site and Beginning-of-Test (T_0) Mussel Tissue Samples

Table 3.2-10. PAH Distribution by Source: Pyrogenic, Biogenic, and Petrogenic. Concentration (ng/g dw) and percent of total PAH

		Hazel	*Hilda*	*Shallow Ref*	*Heidi*	*Hope*	*DeepRef*	*TimeZero*	*w/o HildaOutlier*
Concentration (ng/g dw)									
Pyrogenic									
	Replicate 1	NR	17.01	14.50	15.91	12.29	9.47	49.44	17.007
	Replicate 2	12.85	15.16	17.05	16.49	17.39	13.53	45.08	15.158
	Replicate 3	13.52	13.52	13.33	12.99	NR	15.47	33.69	OE
	Mean	**13.19**	**15.23**	**14.96**	**15.13**	**14.84**	**12.82**	**42.74**	**16.08**

Table 3.2-10. PAH Distribution by Source: Pyrogenic, Biogenic, and Petrogenic. Concentration (ng/g dw) and percent of total PAH

		Hazel	*Hilda*	*Shallow Ref*	*Heidi*	*Hope*	*DeepRef*	*TimeZero*	*w/o HildaOutlier*
Biogenic									
	Replicate 1	NR	0	0	0	0	2.63	0	0
	Replicate 2	0	0	0	0	0	0	0	0
	Replicate 3	0	0	0	0	NR	2.66	0	OE
	Mean	**0**	**0**	**0**	**0**	**0**	**2.65**	**0**	**0**
Percent of total PAH (mean by station)									
Pyrogenic		16.7%	40.2%	21.8%	23.2%	21.8%	20.6%	26.1%	17.9%
Biogenic		0.0%	0.0%	0.0%	0.0%	0.0%	2.6%	0.0%	0.0%
Petrogenic		83.3%	59.8%	78.2%	76.8%	78.2%	76.8%	73.9%	82.1%
Note: NR = cage not retrieved; OE = outlier excluded									

Table 3.2-11. Content of Low Molecular Weight (LMW), High Molecular Weight (HMW), and Total PAHs (ng PAH/mussel)

	Hazel	*Hilda*	*ShallowRef*	*Heidi*	*Hope*	*DeepRef*	*TimeZero*	*w/o HildaOutlier*
Low Molecular Weight PAHs (ng PAH/mussel)								
Replicate 1	NR	50.87	50.56	39.98	32.43	35.34	76.29	50.867
Replicate 2	54.86	56.84	41.00	42.01	39.22	26.15	71.51	56.837
Replicate 3	54.70	10.79	36.42	41.10	NR	39.05	63.80	OE
Mean	**54.78**	**39.50**	**42.66**	**41.03**	**35.83**	**33.51**	**70.53**	**53.85**
95% CI	0.16	28.34	8.16	1.15	6.65	7.51	7.13	5.85
n	2	3	3	3	2	3	3	2
High Molecular Weight PAHs (ng PAH/mussel)								
Replicate 1	NR	26.75	16.53	2.79	7.18	2.88	44.68	26.751
Replicate 2	6.21	22.80	4.93	3.11	11.13	1.92	39.34	22.804
Replicate 3	22.95	3.44	12.50	10.12	NR	4.71	31.34	OE

Table 3.2-11. Content of Low Molecular Weight (LMW), High Molecular Weight (HMW), and Total PAHs (ng PAH/mussel)

	Hazel	*Hilda*	*ShallowRef*	*Heidi*	*Hope*	*DeepRef*	*TimeZero*	*w/o HildaOutlier*
Mean	**14.58**	**17.66**	**11.32**	**5.34**	**9.16**	**3.17**	**38.45**	**24.78**
95% CI	16.40	14.12	6.67	4.69	3.87	1.60	7.60	3.87
n	2	3	3	3	2	3	3	2
TOTAL PAHs (ng PAH/mussel)								
Replicate 1	NR	77.62	67.09	42.76	39.62	38.22	120.96	77.618
Replicate 2	61.07	79.64	45.93	45.12	50.35	28.07	110.85	79.641
Replicate 3	77.64	14.22	48.92	51.22	NR	43.75	95.13	OE
Mean	**69.35**	**57.16**	**53.98**	**46.37**	**44.98**	**36.68**	**108.98**	**78.63**
95% CI	16.24	42.09	12.96	4.94	10.52	9.00	14.73	1.98
n	2	3	3	3	2	3	3	2

Notes: Content = ng PAH (dw)/mussel = [PAH] ng/g-dw * tissue weight (g-dry)
NR = cage not retrieved
OE = outlier excluded

3.4 SURFICIAL SEDIMENTS

3.4.1 Grain Size

The median grain size of surface sediments near the shell mound and reference stations ranged from 12 and 32 microns (µm), and silts and clays comprised between 76 and 99% of the sediments (Table 3.4-1). Figure 3.4-1 compares percentages of silts and clays (i.e., fines) in sediments near the shell mounds with those at the reference sites and at sites on the eastern portion of the Santa Barbara Channel that were sampled during the Bight'98 Regional Monitoring Program (Noblet et al., 2003). This figure illustrates that sediment grain sizes near the shallow and deep shell mounds were comparable to (i.e., within the respective ranges) those at the corresponding shallow and deep reference sites as well as other locations on the shelf portion of the Santa Barbara Channel.

3.4.2 General Chemistry

Concentrations of total organic carbon (TOC), dissolved and total sulfides, and ammonia in surface sediments near the shell mounds and reference sites are summarized in Table 3.4-2.

Table 3.4-1. Grain Size Distributions for Surficial Sediments Near the Shell Mound and Reference Sites

Parameter			Units	Hazel	Hilda	Shallow Ref	Hope	Heidi	Deep Ref
Median Grain Size			Description	Silt	Silt	Silt	Silt	Silt	Silt
Median Grain Size			Microns	16-36	15-32	23	12-17	9-13	12
Particle Size Distribution, (Wt. Percent)	Gravel		%	0.00	0.00	0.00	0.00	0.00	0.00
	Sand	Coarse	%	0.00	0.00	0.00	0.00	0.00	0.00
		Medium	%	0.00-0.04	0.00-0.75	0.00	0.00-0.63	0.00	0.04
		Fine	%	9.5-24	6.6-23	9.6	5.6-23	0.96-7.7	10
	Silt		%	60-70	62-79	70	59-73	64-74	67
	Clay		%	14-20	12-18	15	17-22	21-31	23
Silt and Clay			%	76-90	76-93	85	76-94	92-99	90

Table 3.4-2. Ranges of Total Organic Carbon (%), Dissolved and Total Sulfides, and Ammonia (mg/kg) in Surficial Sediments in the Vicinity of Shell Mounds and Reference Sites

Analyte	*Hazel*	*Hilda*	*Shallow Ref*	*Hope*	*Heidi*	*Deep Ref*
TOC	0.29-0.37	0.41-0.63	0.29	0.47-1.3	0.50-0.75	0.63
Dissolved Sulfides	< 0.17	< 0.19	< 0.16	< 0.21	< 0.21	< 0.21
Total Sulfides	< 0.17	< 0.19	< 0.16	< 0.21	< 0.21	< 0.21
Ammonia	1.6-4.8	1.0-5.6	3.6	1.9-3.5	1.9-7.1	1.8

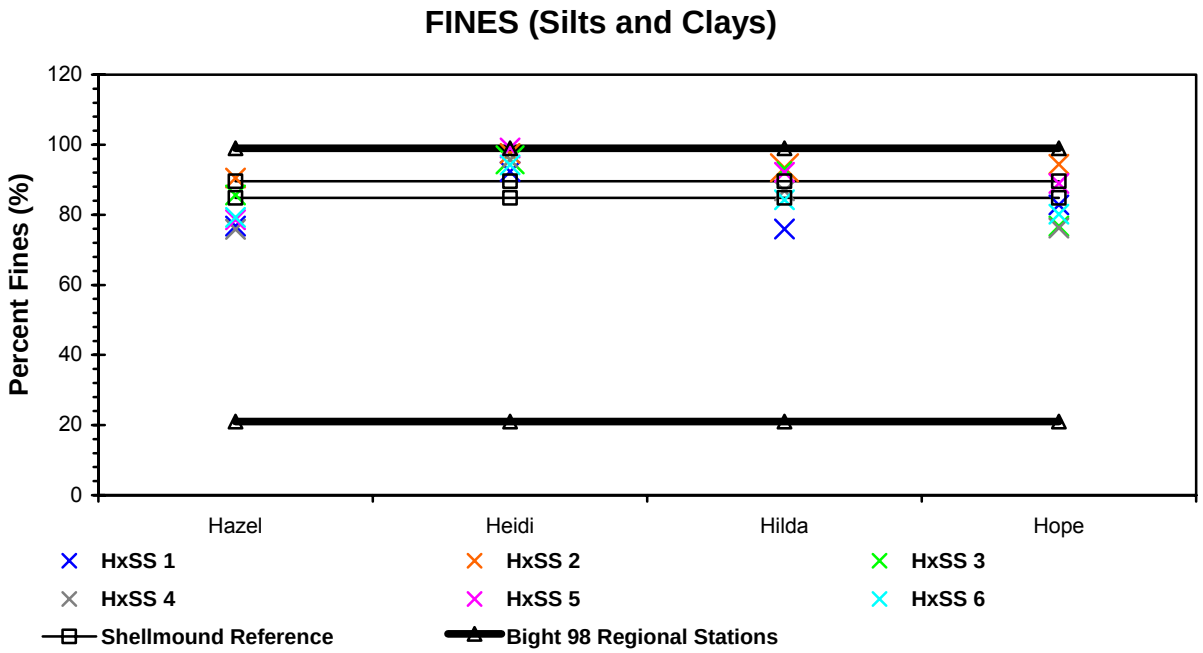

Figure 3.4-1. Comparison of Fines (% Silts + Clays) in Sediments Near the 4H Shell Mounds with those of the Shallow and Deep Reference Sites (thin horizontal lines) **and Bight '98 Regional Monitoring Program Sites in the Santa Barbara Channel** (thick horizontal lines)

The ranges in TOC concentrations in sediments near the shell mounds typically overlapped with those of the corresponding reference site, with the exception that sediments near the Hilda shell mound contained higher concentrations than those at the shallow reference site (Figure 3.4-2). Ammonia concentrations at the deep reference site were slightly lower than the low ends of the respective ranges for the Hope and Heidi mound sites, whereas concentrations at the shallow shell mound sites overlapped with those at the shallow reference site. Dissolved and total sulfides concentrations were not detected in any of the near-mound or reference site sediments.

3.4.3 Trace Metals

Concentrations of trace metals in surficial sediments at the shell mound and reference sites are summarized in Table 3.4-3. The metals antimony, beryllium, selenium, silver, and thallium typically were not detected in the surficial sediment samples collected near the shell mounds or at reference stations. Concentrations of metals other than barium and, to a lesser extent, zinc in sediments near the shell mounds generally were comparable to those at the corresponding reference stations and to the ranges in concentrations measured at a series of sites within the general area of the shell mounds during the Bight'98 Regional Monitoring Program. Barium concentrations were elevated

in at least one of the six sediment samples collected near each of the four mounds, with maximum concentrations (2,110 mg/kg) that were more than one order of magnitude higher than those in sediments from the shallow and deep reference sites (157 and 148 mg/kg, respectively) (Figure 3.4-3). Barium often is used as a chemical tracer for drilling muds in the marine environment because it is highly enriched in drilling wastes compared with background sediment concentrations, virtually insoluble in seawater, and not chemically degraded (e.g., Trocine and Trefry, 1983; Phillips et al., 1998). The maximum zinc concentration (155 mg/kg at the Hilda mound site) was approximately two times higher than the corresponding reference site concentration (71 mg/kg) (Figure 3.4-4). In general, the highest zinc concentrations co-occurred in samples with high barium concentrations, suggesting a common source. Although the spatial density of samples collected was limited, the results did not indicate any consistent gradients near the shell mounds (Figure 3.4-5). Instead, samples with highest barium and zinc occurred at varying distances and directions relative to the adjacent shell mound. The sample Heidi SS3 (collected approximately 100 m offshore from the Heidi shell mound) contained cadmium, chromium, copper, and nickel concentrations that were greater than the respective deep reference site values. However, the barium concentration in this sample was not elevated, suggesting that presence of elevated cadmium, chromium, copper, and nickel was attributable to sources other than the shell mounds or drilling residues.

Table 3.4-3. Ranges in Metal Concentrations (mg/kg) in Surficial Sediments Collected Near the Shell Mounds and Reference Sites

Analyte	*Hazel*	*Hilda*	*Shallow Ref*	*Hope*	*Heidi*	*Deep Ref*
Antimony	< 1.67	< 1.69-2.8	< 1.64	< 2.2	< 2.08	< 2.1
Arsenic	5.9-8.3	7.4-10	7.1	6.6-10	7.6-12	11
Barium	193-2110	163-1960	157	181-1890	226-1720	148
Beryllium	< 1.7	< 1.8	< 1.6	< 2.2	< 2.1	< 2.1
Cadmium	< 1.5-2.4	<1.7-2.5	< 1.6	<2.0-2.7	< 1.9-3.2	2.6
Chromium	28-35	34-40	30	32-47	35-51	40
Cobalt	5.4-6.7	6.7-7.6	7.2	6.0-9.4	8.5-11	9.8
Copper	11-14	14-16	14	16-22	18-29	23
Lead	8.5-12	11-34	10	14-18	13-18	16
Molybdenum	< 1.7	< 1.8	< 1.6	< 1.8-2.7	< 1.9-2.6	< 2.1
Nickel	29-36	35-40	32	25-40	37-56	38
Selenium	< 1.67	< 1.69-2.8	< 1.6	< 2.2	< 2.1	< 2.1
Silver	< 1.67	< 1.69-2.2	< 1.6	< 2.2	< 2.1	< 2.1
Thallium	< 1.67	< 1.8	< 1.6	< 2.2	< 2.1	< 2.1
Vanadium	30-39	40-48	39	41-68	46-68	61
Zinc	72-125	76-155	72	79-153	96-148	101
Mercury	< 0.032	< 0.039	0.0535	0.048-0.064	0.052-0.10	0.065

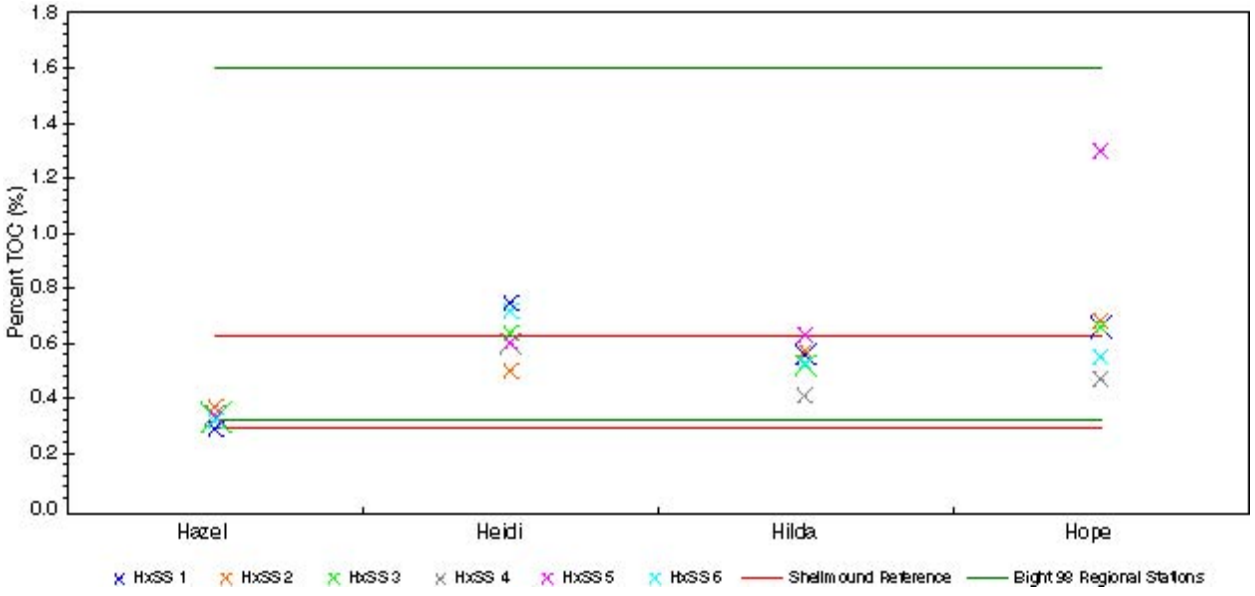

Figure 3.4-2. Comparison of Total Organic Carbon Concentrations (% dry weight) in Sediments Near the 4H Shell Mounds with those of the Shallow and Deep Reference Sites and Bight '98 Regional Monitoring Program Sites in the Santa Barbara Channel

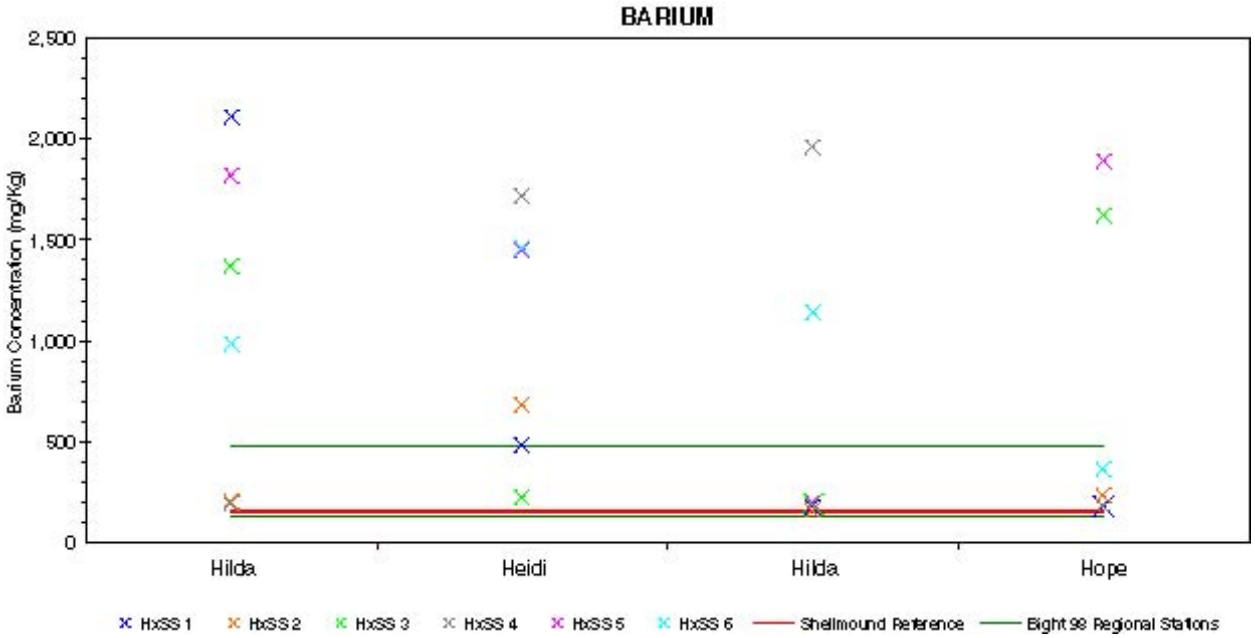

Figure 3.4-3. Comparison of Barium Concentrations (mg/kg dry weight) in Sediments Near the 4H Shell Mounds with those of the Shallow and Deep Reference Sites and Bight '98 Regional Monitoring Program Sites in the Santa Barbara Channel

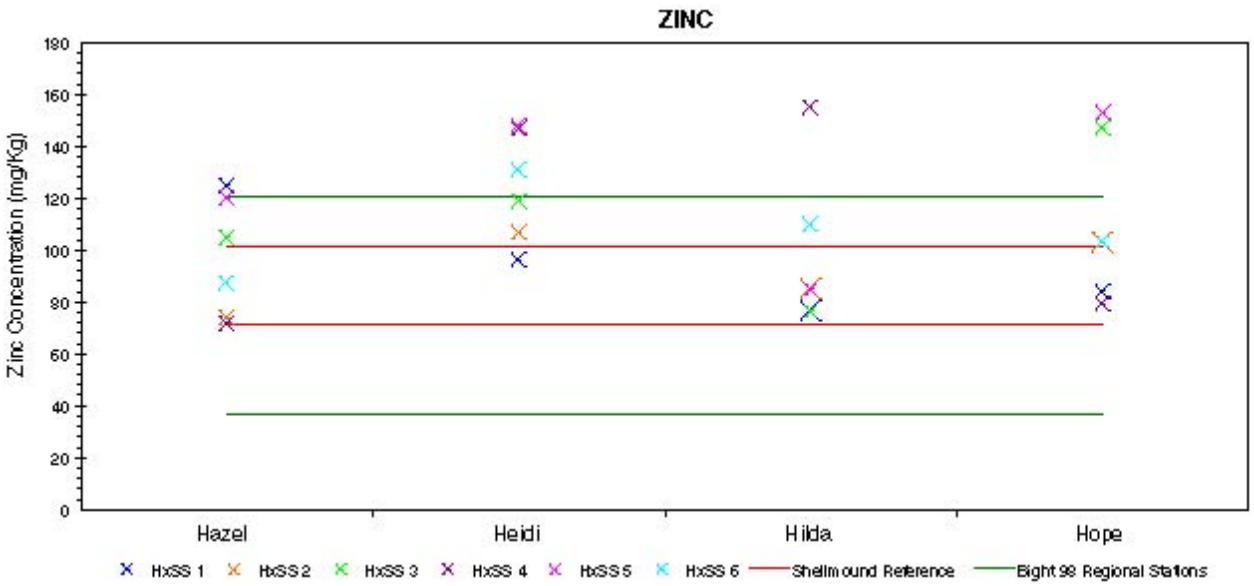

Figure 3.4-4 . Comparison of Zinc Concentrations (mg/kg dry weight) in Sediments Near the 4H Shell Mounds with those of the Shallow and Deep Reference Sites and Bight '98 Regional Monitoring Program Sites in the Santa Barbara Channel

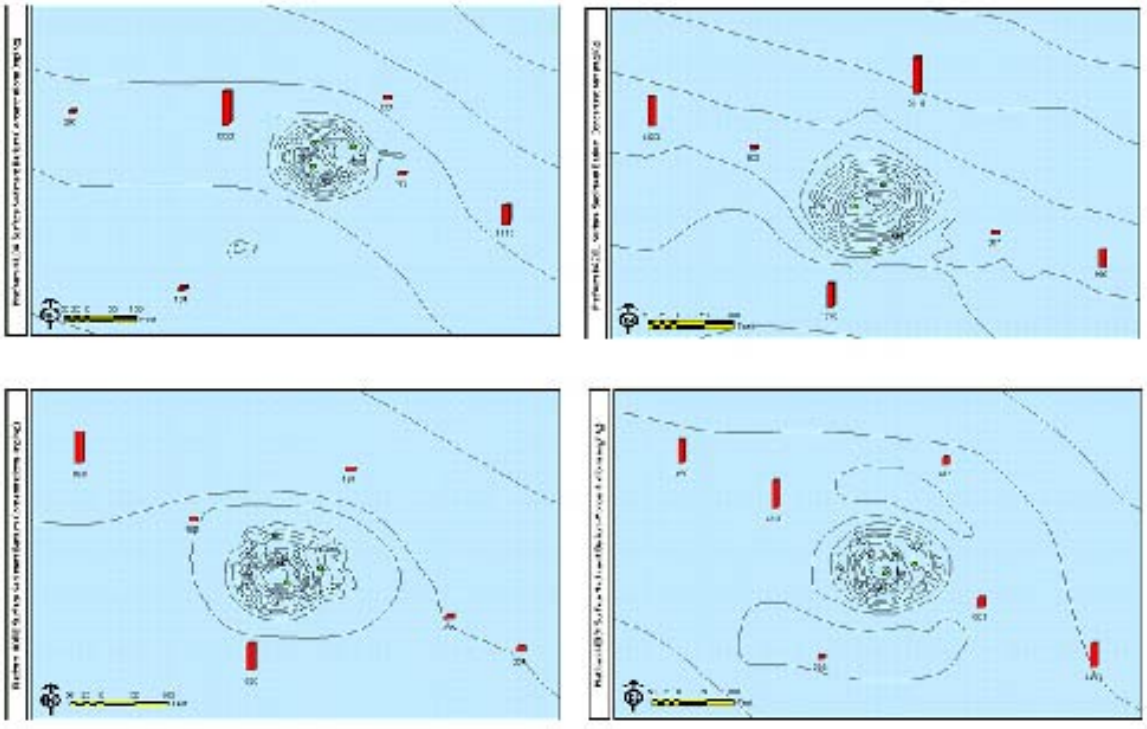

Figure 3.4-5. Distributions of Barium (mg/kg dry weight) in Surface Sediments Near Each of the 4H Shell Mounds

Table 3.4-4. Concentrations (ng/g) of Organotins in Surficial Sediments Near the Shell Mounds and Reference Sites

Analyte	*Hazel*	*Hilda*	*Shallow Ref*	*Hope*	*Heidi*	*Deep Ref*
Monobutyltin	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Dibutyltin	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Tributyltin	< 1.0-1.0	< 1.0	1.0	1.1-3.5	< 1.0-2.1	< 1.0
Tetrabutyltin	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

3.4.4 Organotins

Results from organotin analyses of surficial sediments are summarized in Table 3.4-4. Trace levels (i.e., at or near the method reporting limit) of tributyltin were present near the Hazel, Hope, and Heidi shell mounds, whereas organotins were not detected in sediments near the Hilda shell mound or the two reference sites. For comparison, organotins were detected at concentrations up to 14 ng/g in core sediments from the Hilda and Hope shell mounds, but they were not detected in the Hazel and Heidi shell mound cores (AMEC, 2002b).

3.4.5 Pesticides and PCBs

Ranges in the concentrations of detected chlorinated pesticides and PCBs (Aroclors) in surface sediments near the shell mounds and reference sites are summarized in Table 3.4-5. DDT and its principal metabolite, DDE, and dieldrin were the only chlorinated pesticides detected in the sediment samples. The DDT metabolite p,p′-DDE was present at measurable concentrations in sediment samples near all of the 4H shell mounds as well as the reference stations. The highest concentration measured was 22 ng/g. The parent compound, p,p′-DDT, was also detected in sediments near the Hilda, Hope, and Heidi shell mounds but not at the reference sites. The pesticide dieldrin was detected in at least one sediment sample from each of the Hilda and Hope sites but not at the reference sites. Although DDT and DDT metabolites were detected in sediment cores from the shell mounds, the presence of these and other pesticides likely were related to regional input sources, such as runoff from land and/or atmospheric deposition, rather than platform-related activities. This is consistent with the results from the shell mound core analyses (AMEC, 2002b), which showed only trace quantities (<1 ng/g) in the surface layer of the core from the Heidi shell mound and nondetectable levels in cores from the other 4H shell mounds.

Table 3.4-5. Concentrations of Selected Pesticides and PCBs (ng/g) for Surficial Sediments Collected Near the Shell Mounds and Reference Sites
(None of the other pesticides or Aroclors were detected in any of the sediment samples.)

Analyte	*Hazel*	*Hilda*	*Shallow Ref*	*Hope*	*Heidi*	*Deep Ref*
Dieldrin	<1.7	<1.7-2.2	<1.6	<1.9-2.7	< 2.1	<2.1
p,p′-DDE	<1.5-8.6	<1.8-22	5.6	<2.2-20	2.9-9.8	4.3
p,p′-DDT	<1.5-11	<1.8-48	<1.6	<2.2-9.9	<1.9-2.2	<2.1
Aroclor-1254	<15-190	<17-160	<16	<21-96	<21	<21
Aroclor-1260	<17	<18-590	<16	<22	< 21	<21

PCBs (Aroclor 1254 and, at Hilda only, 1260) were detected in sediments near the Hazel, Hilda, and Hope shell mounds, but not near the Heidi shell mound or at either of the shallow or deep reference sites. This was consistent with the distribution of Aroclor 1254 in sediment cores collected from shell mounds (AMEC, 2002b). The highest concentration (590 ng/g) occurred in a sediment sample near the Hilda shell mound, and concentrations of total PCBs (sum of detected Aroclors) in one or more sediment samples from each of the Hazel, Hilda, and Hope shell mounds exceeded the respective range for the reference sites and for nearby sites sampled during the Bight'98 Regional Monitoring Program (Figure 3.4-6). The spatial distributions of PCBs in sediments near the Hazel, Hilda, and Hope shell mounds generally were more uniform than those of barium, and appeared to reflect gradients in concentrations with distance from the mounds in the along-isobath directions (Figure 3.4-7).

3.4.6 Polycyclic Aromatic Hydrocarbons (PAHs)

Ranges in the concentrations of individual polycyclic aromatic hydrocarbons in surficial sediments near the shell mounds and at the shallow and deep reference sites are shown in Table 3.4-6. Only one sediment sample collected near the Hope shell mound contained detectable levels of phenanthrene and pyrene, while one sample collected near the Hilda shell mound contained an unusually high concentration of benzo(a)anthracene. No PAHs were detected in sediments near the Hazel or Heidi shell mounds or at either of the shallow or deep reference sites. Phenanthrene and pyrene were both present in the sediment cores collected from the Hope shell mound, whereas benzo(a)anthracene was not detected in any of the shell mound cores (AMEC, 2002b). Pyrene and benzo(a)anthracene are considered more characteristic of combustion sources of PAHs, whereas phenanthrene can be associated with both combustion and petroleum sources. This suggests that detectable levels of pyrene and benzo(a)anthracene were due to sources other than the shell mounds.

Table 3.4-6. Concentrations of PAHs (ng/g) in Surficial Sediments Near the Shell Mounds and Reference Sites

Analyte	*Hazel*	*Hilda*	*Shallow Ref*	*Hope*	*Heidi*	*Deep Ref*
Naphthalene	<27	<30	<26	<35	<33	<34
Acenaphthylene	<27	<30	<26	<35	<33	<34
Acenaphthene	<27	<30	<26	<35	<33	<34
Fluorene	<27	<30	<26	<35	<33	<34
Phenanthrene	<27	<30	<26	<35-45	<33	<34
Anthracene	<27	<30	<26	<35	<33	<34
Fluoranthene	<27	<30	<26	<35	<33	<34
Pyrene	<27	<30	<26	<35-94	<33	<34
Benzo (a) Anthracene	<27	<30-1700	<26	<35	<33	<34
Chrysene	<27	<30	<26	<35	<33	<34
Benzo (k) Fluoranthene	<27	<30	<26	<35	<33	<34
Benzo (b) Fluoranthene	<27	<30	<26	<35	<33	<34
Benzo (a) Pyrene	<31	<26	<23	<31	<29	<30
Indeno 1,2,3-c,d) Pyrene	<27	<30	<26	<35	<33	<34
Dibenz (a,h) Anthracene	<27	<30	<26	<35	<33	<34
Benzo (g,h,I) Perylene	<27	<30	<26	<35	<33	<34

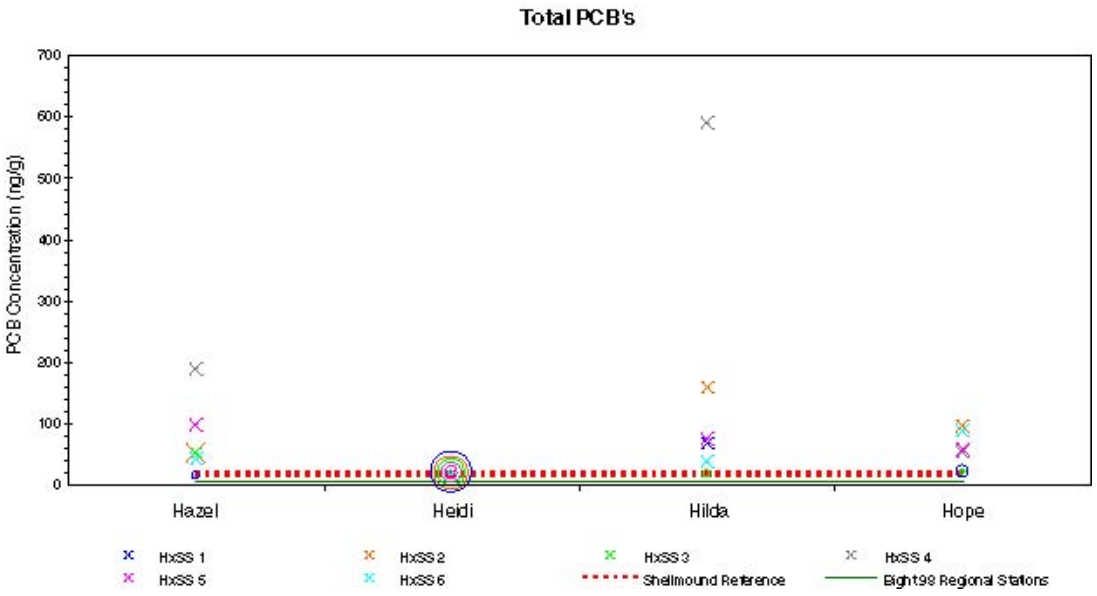

Figure 3.4-6. Comparison of PCB Concentrations (ng/g dry weight) in Sediments Near the 4H Shell Mounds with those of the Shallow and Deep Reference Sites and Bight '98 Regional Monitoring Program Sites in the Santa Barbara Channel
(Circles represent non-detected results.)

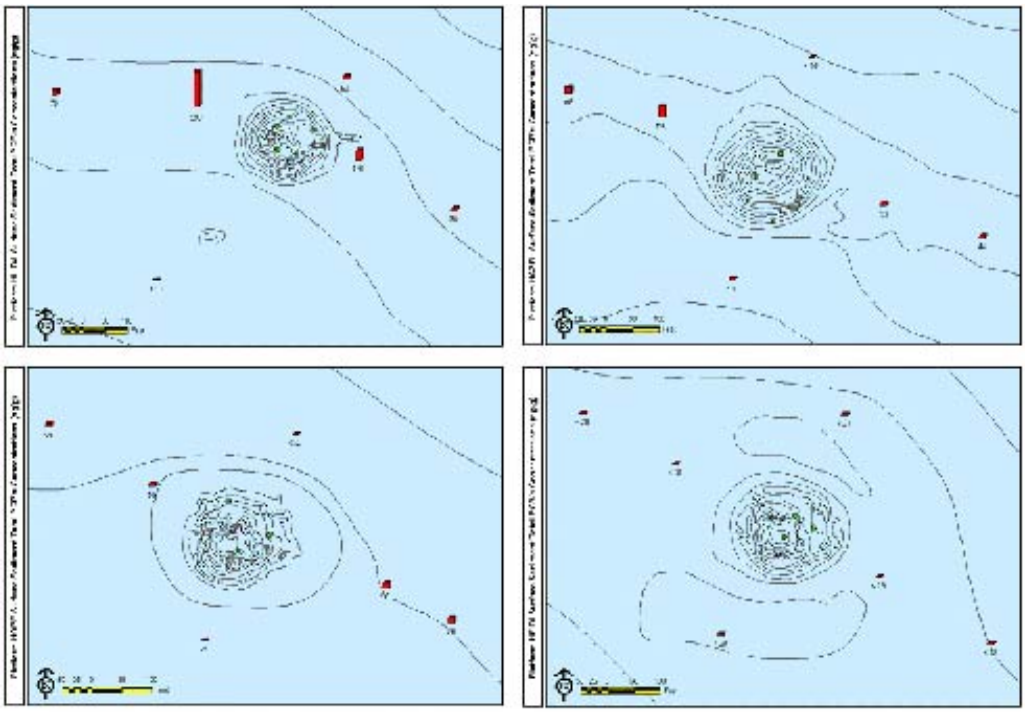

Figure 3.4-7. Distributions of PCBs (ng/g dry weight) in Surface Sediments Near Each of the 4H Shell Mounds

3.4.7 Total Petroleum Hydrocarbons (TPH) and Total Recoverable Petroleum Hydrocarbons (TRPH)

Concentration ranges for total petroleum hydrocarbons, total recoverable petroleum hydrocarbons, and individual and summed alkanes (straight chain hydrocarbon compounds) are listed in Table 3.4-7. Individual and summed alkanes generally were at or below the reporting limits in sediments from the vicinity of the Hope shell mound as well as both the shallow and deep reference sites. Detectable levels of some of the heavier alkane compounds (C19 through C40) were present in one or more sediment samples collected near the shallow mound sites (Hazel and Hilda), although the total (C7 through C40) concentrations were less than 50 mg/kg. In contrast, one of the sediment samples collected near the Heidi shell mound contained detectable concentrations of the C13 through C40 alkanes, and a summed concentration of 240 mg/kg. The TRPH concentrations ranged from 60 to 200 mg/kg across all sites, and the distributions did not match those of the TPH concentrations. The source(s) of the hydrocarbons in the bottom sediments could not be determined from these data.

Table 3.4-7. TPH and TRPH Concentrations (mg/kg) in Surficial Sediments Near the Shell Mounds and Reference Sites

Analyte	*Hazel*	*Hilda*	*Shallow Ref*	*Hope*	*Heidi*	*Deep Ref*
C7	<8.0	<9.3	<8.2	<11	<10	<11.0
C8	<8.0	<9.3	<8.2	<11	<10	<11.0
C9 – C10	<8.0	<9.3	<8.2	<11	<10	<11.0
C11 – C12	<8.0	<9.3	<8.2	0.74-<11	<10	<11.0
C13 – C14	<8.0	<9.3	<8.2	2.8-<11	<10	<11.0
C15 – C16	<8.0	<9.3	<8.2	5.1-<11	<10	<11.0
C17 – C18	0.6-< 7.7	<9.3	<8.2	<9.3-11	<10	<11.0
C19 – C20	0.27-< 7.7	0.60-<9.3	<8.2	<9.3-15	<10	<11.0
C21 – C22	0.28-< 7.7	2.8-<9.3	<8.2	<9.3-18	<10	<11.0
C23 – C24	0.48-< 7.7	2.5-<9.3	<8.2	<9.3-18	<10	<11.0
C25 – C28	1.4-< 7.7	6.9-<9.3	<8.2	0.062-32	0.19-<10	<11.0
C29 – C32	4.3-< 7.7	8.9-<9.3	<8.2	0.68-56	3.6-<10	<11.0
C33 – C36	4.3-< 7.7	6.2-<9.3	<8.2	0.13-27	0.50-<10	<11.0
C37 – C40	4.6< 7.7	4.6-<9.3	<8.2	0.25-46	4.4-<10	<11.0
C7 – C44 (Total)	< 7.7-43	<8.8-35	<8.2	<9.3-240	<10	<11.0
TRPH	110-150	130-200	80	44-100	60-120	140

3.4.8 Volatile Organic Compounds (VOCs)

With the exception of acetone, volatile organic compounds were not detected in any of the sediments from the vicinity of the 4H shell mounds or the reference sites. The presence of detectable levels of acetone was likely due to inadvertent contamination in the analytical chemistry laboratory, although it was not detected in any of the three method blanks that were prepared and analyzed with the sediment samples. Volatile organic compounds, including acetone, are soluble in water and typically do not accumulate or persist in surficial marine sediments.

3.4.9 Phenols and Phthalates

Phenolic compounds were not detected in any of the sediment samples from the vicinity of the 4H shell mounds or at the reference sites. In contrast, three phthalate compounds – di-N-butyl, butyl-benzyl, and bis 2-ethylhexyl – occurred sporadically in samples from near the shell mounds and from the reference sites. The presence of detectable levels of phthalates was likely due to inadvertent contamination in the analytical chemistry laboratory, although they were not detected in the method blanks that were prepared and analyzed with the sediment samples.